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ABSTRACT

This guide, designed for teacher use, focuses on the evaluation of environmental education experiences. The guide, which is based on a doctoral study, is structured around three basic evaluation questions: (1) What kinds of environmental education learning experiences can you evaluate?; (2) What outcomes of environmental education learning experiences can you look for?; and (3) How can you determine the extent to which the outcomes have been achieved? This guide is divided into three sections which deal with the evaluation questions. The first section considers the goals of environmental education. The three phases of the environmental education process (discovery and inquiry; evaluation and problem identification; and problem solving) are considered. The relationship between what a person knows and feels in relation to his value system, and how environmental education can affect and change this relationship is discussed to answer question 2. Section three deals with the third question; behavioral objectives as tools for evaluating skills in discovery and inquiry, evaluation and problem identification, and problem solving are examined. Sample test items are included. The appendices include evaluation considerations, a unit outline example, and the results of an evaluation. (TK)

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Yarmouth, Maine
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GUIDELINES for evaluating student outcomes in environmental education



MAINE ENVIRONMENTAL EDUCATION PROJECT
TITLE III ESRA

YARMOUTH, MAINE

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GUIDELINES
for
EVALUATING STUDENT OUTCOMES
in
ENVIRONMENTAL EDUCATION

Maine Environmental Education Project
TITLE III, E.S.E.A.

by
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Yarmouth, Maine
1973

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Introduction

This guide is intended for the teacher, the curriculum developer, the administrator and others who wish to examine, critically, the results of educational experiences. It is based upon a doctoral study designed to develop and test a model for evaluating student outcomes in environmental education.*

To increase the usefulness of the guide, it is structured around three basic evaluation questions:

1. What kinds of environmental education learning experiences can you evaluate?
2. What outcomes of environmental education learning experiences can you look for?
3. How can you determine the extent to which the outcomes have been achieved?

The answers to these three questions should provide helpful suggestions to those concerned with meaningful evaluation.

* Dean Birchard Bennett, "The Development of a Model to Evaluate the Attitudinal and Behavioral Goals of K-12 Environmental Education," Unpublished Doctoral Dissertation, The University of Michigan, 1972.

I. What kinds of environmental education learning experiences can you evaluate?

Within recent years there has been an increased recognition of the need for environmental planning and decision-making responsibility on the part of all citizens. This, coupled with the current emphasis on the reappraisal of American education and on curriculum reform, has given impetus to the establishment of education programs which relate to man and his environment.

The Goals of Environmental Education

It is clear today that environmental education, as it is called, is directed towards the development of attitudes and behavioral skills in the area of environmental decision-making and problem solving. Accordingly, the Maine Environmental Education Project defines environmental education as a process aimed at producing a citizenry that is knowledgeable concerning the total environment and the role of man, able to participate in activities for maintaining and improving the quality of the environment while meeting human needs, and motivated to do so.

Derived from this goal and definition are the following subgoals:

1. (Affective Subgoal)

To help individuals acquire strong feelings fundamental to developing a concern for the environment and a motivation to participate in activities for maintaining and improving the quality of the total environment.

2. (Cognitive Subgoal)

To help individuals acquire basic understanding of the total natural and man-made environment, their relationship with this environment, and common environmental problems.

3. (Behavioral-Skill Subgoal)

To help individuals develop the necessary thinking and behavioral skills for the prevention of environmental degradation, the correction of environmental

abuses, and the alteration and use of natural resources to enhance the function and quality of the environment to meet ecological including human needs.

Environmental Education As A Process

Environmental education is viewed as a process in which the student participates in three levels of learning experiences:

- 1) discovery and inquiry,
- 2) evaluation and problem identification, and
- 3) problem solving.

Problem identification and problem solving as used here involve not only the recognition, prevention, and resolution of environmental problems but the activities in which students alter and create components in their environment to enhance its function and quality. Students may either act directly on the environment or communicate a concern to others to encourage their participation.

The environmental education learning process emphasizes first-hand experiences focusing on the total environment of the community and immediate surroundings of the student, for example, the school site or neighborhood. The three phases of the process also include classroom experiences.

This approach to environmental education provides an interdisciplinary means of developing values, attitudes, conceptual understandings, critical thinking and behavioral skills.

The process may be carried out by students participating in studies relating to the components of the total natural and man-made environment and related social, political and economic aspects. Figure One suggests how the environmental education process may relate to the study of a natural component of the environment. Figure Two is an outline for the study of walkways and pathways as examples of a man-made environmental component. It should be stressed that it is not particularly important which of the many environmental components is studied nor that all the components be studied. Rather, it is the process and associated cognitive, affective and skill outcomes which should be emphasized and which will carry over with the student.

FIGURE 1

THE PROCESS OF
ENVIRONMENTAL EDUCATION

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Natural Environment Example: Trees (plants)

Discovery - Inquiry	Evaluation - Problem Identification	Problem Solving
Classroom activities - Learn about the characteristics, interrelationships, changes, and uses of trees through lessons, books and publications, resource people, films, and other instructional aids.	Group or independent development of criteria to assess: 1) how well trees meet ecological needs, e.g., hold soil, prevent erosion, provide homes for wildlife, etc., and 2) how well trees meet human needs, e.g., physical shade, etc.; psychological needs, aesthetics, etc.; social needs, gathering places, etc. Evaluate how well trees meet these needs in a real or hypothetical situation to identify environmental improvement opportunities.	Select a hypothetical problem, e.g., landscape a small park with trees. 1. Investigate the problem - needs, kinds of trees, etc. 2. Develop alternative solutions, plans for different plantings in a variety of locations. 3. Choose a solution after considering effects of each. 4. Develop plan of action - list steps and items needed. 5. Present plan for evaluation by others.
On-site activities - Investigate the trees on the school site and map and describe the kinds present on the site, their locations, sizes, condition, environmental effects, etc.	Develop evaluative criteria as above and assess extent present trees on the school site meet criteria. Identify: 1) existing conditions which need to be corrected - diseased trees, storm damaged trees, etc., 2) conditions which could be enhanced by planting trees, and 3) conditions threatening trees which should be prevented.	Select a tree problem to resolve on the school site; for example, white pine blister rust, etc. 1. Investigate causes, effects. 2. Develop alternative solutions. 3. Choose a solution. 4. Develop a plan of action. 5. Carry out plan. 6. Evaluate results.

FIGURE 2

THE PROCESS OF ENVIRONMENTAL EDUCATION

Man-Made Environment Example:

Walkways and Pathways (transportation-circulation areas)

Discovery - Inquiry	Evaluation - Problem Identification	Problem Solving
Classroom activities - Learn about the kinds, locations, functions, and characteristics of walkways and pathways through lessons, books and publications, resource people, films, and other instructional aids.	Individual and group development of criteria to assess: 1) effects of walkways and pathways on the natural ecosystem - altering drainage patterns, changing microclimate, removing vegetation, etc., and 2) how well walkways and pathways meet human needs: physical - safety, etc., psychological - aesthetics, etc., and social - bringing people together, etc. Evaluate walkways and pathways in a real or hypothetical landscape design plan.	Select a hypothetical problem, e.g., develop a plan for a new pathway. 1. Investigate the problem - needs, kinds of pathways, etc. 2. Develop alternative solutions - routes, kinds of pathways, etc. 3. Choose a solution after considering effects of each. 4. Develop plan of carrying out solution. 5. Present plan for evaluation by others.
On-site activities - Investigate walkways and pathways on the school site or in the community. Map and describe the kinds, locations, characteristics, conditions, and human and environmental effects.	Apply evaluative criteria as suggested above to walkways and pathways being assessed on site. Identify: 1) existing conditions which need to be corrected - erosion, pot-holes, rerouting, etc., 2) conditions which should be prevented - footwear erosion from overuse, encroachment of vegetation, etc., and 3) conditions which could be enhanced by creating new pathways, signs, etc.	Select a walkway or pathway problem to help resolve on the school site or in the community. 1. Investigate causes and effects. 2. Develop alternative solutions. 3. Choose a solution. 4. Develop a plan of action. 5. Carry out plan. 6. Evaluate results.

II. What outcomes of environmental education learning experiences can you look for ?

SKILL OUTCOMES

The outcomes of environmental education may be stated as behavioral objectives which reflect the three phases of the learning process described in Section I.

1. DISCOVERY AND INQUIRY

The student will be able to and will continually seek to discover and investigate the components and characteristics of his total environment and the relationship of man with this environment.

This includes the following skills:

- a. Recognizing the structure, components and processes in natural and human ecosystems.
- b. Investigating the components and processes.

2. EVALUATION AND PROBLEM IDENTIFICATION

The student will be able to and will continually develop and apply criteria to evaluate the data related to his total environment and associated human processes and to identify opportunities for maintaining and improving his environment.

This includes the following skills:

- a. Developing criteria and evaluating how well ecological — human needs are being or are likely to be satisfied by environmental components and processes.
- b. Identifying opportunities for environmental maintenance and improvement.

3. PROBLEM-SOLVING

The student will be able to and will continually participate in selecting and successfully carrying out environmental problem-solving activities involving the prevention and resolution of environmental problems and the alteration or creation of components to enhance the function and quality of the environment.

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This includes the following skills:

- a. Selecting and defining an issue or problem.
- b. Inquiring to become informed about the problem through investigation.
- c. Determining alternative solutions to the problem.
- d. Evaluating the consequences of solutions and choosing a solution.
- e. Developing a plan of action.
- f. Implementing the plan of action.
- g. Evaluating the process and results.

Each of the above three behavioral outcomes represent skills which may be developed through the "process" learning experiences.

In addition, since a person's behavior is influenced by how he feels and what he knows, related affective (feelings) and cognitive (knowledge) outcomes should also be identified.

KNOWLEDGE AND FEELING OUTCOMES

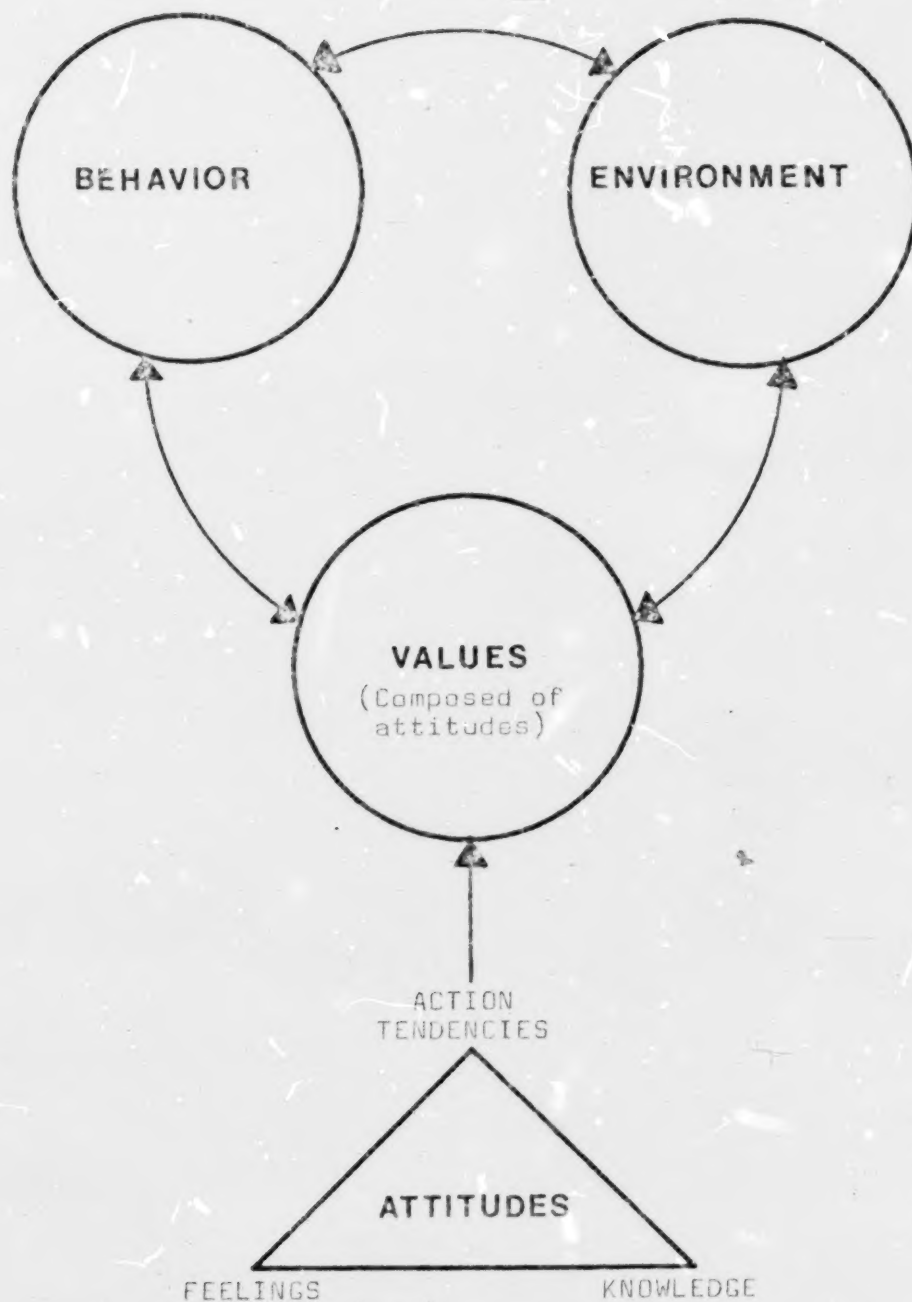
It was suggested in the previous paragraphs that feelings and knowledge motivate and guide behavior. According to popular theory these are two components of attitudes. An attitude is thought of as an inclination to be motivated by, to experience and to act toward objects. Objects may be either concrete, physical objects or abstract ideas. It is further theorized that the tendency to act towards an object is the third component of an attitude and is produced by the other two - feeling and knowledge. Attitudes in turn form values which group to form a value system. Values are basic and enduring motivations to act toward or with respect to what an individual prizes. In this way they may be thought of as clusters of action tendencies necessary for self-motivated behavior. Since action tendencies are produced by knowledge and feelings, it follows that values and subsequent behavior may be developed by helping students acquire feelings and knowledge.

Knowledge in today's curriculum is thought of in terms of basic concepts. The conscious mental processes of interplay and development of values and attitudes and their components are called thinking.

The development of attitudes, values and thinking skills can lead to the occurrence and guidance of overt behavior which in turn may reinforce these variables.

See Figure 3 for a schematic of this theory.

Figure 3: Attitude - Behavioral Model



The goal of environmental education suggests that it aims to help individuals acquire an ecologically oriented value system composed of the following two values with their associated attitudes and identified cognitive and affective components. Again, it is stressed that it is the cognitive components (concepts) and affective components (feelings) that this guide focuses on for evaluation. The following scheme is presented as a way of showing how they were derived from the goal of environmental education.

An ecologically oriented value system is composed of:

1. Value of Nature

A value of nature consists of attitudes toward nature. Attitudes toward nature are composed of:

a. Affective Components

These components are characterized by an awareness, appreciation and concern for the existing and future aspects of the natural environment.

b. Cognitive Components

These components are characterized by the following ecological concepts:

1) Natural Ecosystem - Structure and Function

The natural environment of the Earth is essentially a closed and finite system composed of natural ecosystems having:

a) Structure and Components

Structure is related to the diversity of plants and animals, including producers, consumers, decomposers, and transformers which utilize matter - land, water, air - and energy.

b) Function

Energy flows and matter cycles through plants and animals at varying rates.

2) Natural Ecosystem - Characteristics, Interrelationships, and Changes

The characteristics, interrelationships and changes of the components relate to the functioning of natural ecosystems in a process tending ideally toward stability.

- a) Characteristics of location, diversity, quantity and quality of components are involved in the functioning of the natural environment.
- b) Interrelationships between components provide for use and cycling of matter and the use and flow of the sun's energy.
- c) Changes occur continually in both the structure and function of natural ecosystems.

3) Natural Ecosystem Stability

Stability is a measure of a healthy and lasting environment and results from natural ecosystems possessing characteristics, interrelationships and changes which reflect:

- a) Structure
 - (1) A complex network of diverse species with balanced populations.
 - (2) Availability of matter.
- b) Function
 - (1) Efficient utilization of energy.
 - (2) Efficient cycling of matter.

2. Value of the Role of Man as a Steward and Creator of His Environment

A value of the role of man consists of attitudes toward the role of man as a steward and creator, attitudes toward oneself (self-concept) and attitudes towards others (social concept).

a. Attitudes Toward the Role of Man

1) Affective Components

These components are characterized by a positive feeling that man should be both a steward and creator of a quality environment now and for the future.

2) Cognitive Components

These components are characterized by the following human ecosystem concepts:

a) Human Environmental Dependency and Needs

Man is the linking component between the natural environment upon which he is dependent and of which he must be a steward and the man-made environment which he creates to help provide for physical, psychological, and social needs: (The following are needs which provide criteria for environments' evaluation.)

- (1) Human physical needs are provided for by environmental components which function and possess characteristics related to:
 - (a) Convenience and efficiency
 - (b) Safety and health
 - (c) Durability or lastingness
- (2) Human psychological needs are met by components which are pleasurable to the senses.
- (3) Human social needs are met by components which assist people to live in harmony together, to interact, and to gain a measure of individual and group recognition.

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b) Human Ecosystem - Structure and Function

Man exercises stewardship and provides for his needs by working on the natural environment through an institutional system of man-to-man relationships and a technological system of man-to-environment relationships to produce and manage the following components of the man-made environment:

- (1) Production areas
- (2) Human settlement areas
- (3) Open space areas
- (4) Transportation and circulation areas
- (5) Recreational areas
- (6) Community service and utility areas

c) Associated Environmental Problems

Environmental issues and problems are often associated with the size, concentration, physical characteristics of the human population and result from the lack of effective individual citizen, institutional, and technological response to existing and future effects of ecological and human demands upon the environment.

b. Attitudes Toward Oneself (self-concept)

1) Affective Components

These components are characterized by a feeling of individual worth and potential.

2) Cognitive Components

These components are characterized by an understanding or knowledge of one's needs, abilities, limitations, and potential.

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c. Attitudes Toward Others (social concept)

1) Affective Components

These components are characterized by a sensitivity to and concern for the needs of others including future generations.

2) Cognitive Components

These components are characterized by an understanding or knowledge of the needs of others including future generations.

III. How can you determine the extent to which the outcomes have been achieved?

On the following pages the cognitive, affective and skill outcomes previously identified have been re-written and described as basic observable and measurable behaviors. These behavioral statements or objectives describe what the student should do, to what extent and under what conditions to indicate that each outcome sought has been achieved. In addition, the desired skills, concepts and feelings are written to relate to each of the three environmental education experiences

- 1) discovery-inquiry
- 2) evaluation and problem identification, and
- 3) problem-solving.

Using the basic behavioral objectives for skills, concepts and feelings as a guide the teacher can develop courses, units, independent studies, presentations, field trips and any number of educational experiences to achieve the identified outcomes. In designing these learning experiences, the teacher might first choose those skills, feelings and concepts he or she wishes to develop. For each of these a basic behavioral objective is suggested. Using these as a guide, the teacher may then write behavioral objectives which describe what the student will do while participating in the unit, presentation, field trip, etc. These are called process or learning activity objectives since they occur while the students are in the process of being involved in the learning experience. Actually, they describe what the teacher should look for during class activities which indicates that students are progressing satisfactorily.

A second kind of behavioral objective can also be developed from each basic behavioral statement. This behavioral objective is used to guide the formal testing of the skills, concept or feeling both before and after the learning experience. In this kind of evaluation students might be asked to take a pencil-and-paper test. Such a test is particularly suited for evaluating skills and knowledge.

A third kind of behavioral statement can be developed from the basic behavioral objective. This is one especially related to evaluating feelings. It is called an unobtrusive evaluation technique because the student is not aware that he is being tested. It is an advantage for the evaluator when determining the presence of certain feelings that the student is not biased by the knowledge that he is being observed by the teacher.

On the next few pages examples of these three evaluative techniques are given. These examples relate to behavioral objectives developed for a junior high school unit on the school environment (see Appendix B for description of the unit). Three unit behavioral objectives, i.e., learning activity, pencil-and-paper, and unobtrusive, in turn have been drawn from the basic behavioral objectives. These describe what a student should do to indicate that he possesses skills, concepts or feelings.

It should be noted that each of the concepts and feelings identified in this booklet may be developed through any of the three learning experiences - discovery-inquiry, evaluation-problem identification, or problem-solving. Therefore, basic behavioral objectives for each concept and feeling may be written which relate to the three activities. In this guide, however, only one basic objective related to one of the three activities has been written as an example.

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SKILLS

DISCOVERY - INQUIRY SKILLS

(Written to be developed through discovery - inquiry learning experiences)

1. SKILL IN RECOGNIZING AND SELECTING TOPICS TO INVESTIGATE

Basic Behavioral Objective: The student will more completely identify and select topics for study related to all the major components of the natural and man-made environment.

Example: Related Process or Learning Activity

Behavioral Objective (what the student will do during the learning experience)

The student will identify the major components and related topics of the total natural and man-made environment of the school site and select one for study.

Example: Related Formal Evaluation Behavioral Objective

The student will, while observing a series of slides of a school site, complete a list of broad environmental topics and components which should be investigated to gain an understanding of the total natural and man-made environment.

Sample Test Item:

Assume that you wish to improve the environment of your school site. First, you decide to learn as much about the total surroundings of your school as you can. This will help you to discover improvement opportunities you can work on.

What are the major natural things in our environment?

As you view the slide, check the list below carefully to see if it includes all the major natural parts of our total environment. If you feel the list is complete, check the space at the top. If incomplete, add to the list.

Major Natural Parts

The list below is complete _____

Land (soils, rocks, minerals, etc.)
Energy (sunlight)
Plants
Animals

If list is incomplete, add here: _____

2. SKILL IN CARRYING OUT AN INVESTIGATION

Basic Behavioral Objective: The student will develop more complete plans and draw upon an increasing number of different sources of relevant and accurate information in his investigation of the components and characteristics of his total environment and man's role in meeting ecological and human needs.

Example: Related Process or Learning Activity

Behavioral Objective

The student will plan the objectives and steps of his investigation and identify and utilize a number of sources of information including first-hand study on-site.

Example: Related Formal Evaluation Behavioral

Objective

The student will, while observing a slide of a component of a school site select the most important kinds of information to gather and arrange a series of investigative steps in a logical order to carry out the gathering and compiling of information.

Sample Test Items:

You have been asked to gather information on the school site which will help identify improvements for the movement of people and vehicles. Included are facilities for walkways, streets and drives and parking areas as shown in the slide.

- a. Listed below are some of the different kinds of information you should gather to help you in finding improvements which could be made for the movement of people and vehicles on the site.

Check the five most important kinds of information you would need.

_____ Who maintains the facilities?

_____ How long have the facilities been in existence?

- _____ What kinds of facilities exist?
- _____ What is the condition of the facilities?
- _____ Where are the facilities located?
- _____ What are the effects of the facilities on people and nature?
- _____ How are the facilities maintained?
- _____ What are the future needs for movement of people and vehicles on the site?

- b. Number the steps below in the way you would go about investigating the traffic and pedestrian facilities on the school site.

- _____ Complete a detailed map of the site's transportation and circulation facilities upon which to show problem areas.
- _____ Prepare a written report on your findings.
- _____ Interview the school maintenance department personnel to determine how well the facilities are meeting needs and record areas where improvements could be made.
- _____ Study and observe the facilities in operation to confirm problems and discover new areas of improvement.
- _____ Take a walk around the site to find out, sketch and note the kinds, sizes and locations of existing facilities.

3. SKILL IN COMPILING INFORMATION

Basic Behavioral Objective: The student will, with an increasing degree of skill, accuracy, and completeness compile and organize collected information in both written and graphic (maps, graphs, etc.) form.

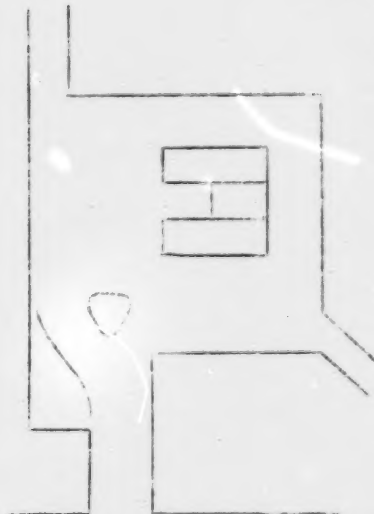
Example: Related Learning Activity Behavioral
Objective

The student will completely and accurately compile information in both written and graphic form.

Example: Related Formal Evaluation Behavioral
Objective

The student will, while observing a series of slides of a school site, correct and complete a map of the site showing the location, shape, and relative size of major components.

Sample Test Item:



Here is a sketch map of your school. Locate your classroom with an X. Change any of the features which are not located properly if this is needed. Add and locate the school flagpole on the map.

EVALUATION - PROBLEM IDENTIFICATION SKILLS

(Written to be developed through evaluation-problem identification learning experiences)

4. SKILL IN DEVELOPING EVALUATIVE CRITERIA

Basic Behavioral Objective: The student will increase in his ability to develop meaningful criteria based upon fundamental natural and human needs and processes for the purpose of seeking meaning from collected data.

Example: Related Learning Activity Behavioral
Objective

The student will develop criteria based upon natural and human needs and processes for the purpose of judging the degree to which selected natural and man-made components meet the identified needs.

Example: Related Formal Evaluation Behavioral
Objective

The student will, while observing a slide showing an unstable and more stable natural environments, select accurate definitions of natural ecosystem stability.

Sample Test Items:

A healthy and lasting natural environment is one which:
(Circle four statements which are more likely to describe a stable environment.)

- 1) contains many different kinds of plants with balanced numbers
- 2) contains only a few kinds of plants but each kind in large number

- 3) has much matter (plant nutrients) available
- 4) has little matter (plant nutrients) because it has been used
- 5) a small amount of the sun's energy is being used by plants and animals
- 6) a large amount of sunlight is being used but it is not being recycled
- 7) matter (nutrients) is being recycled and re-used

5. SKILL IN EVALUATING THE ENVIRONMENT AND IDENTIFYING OPPORTUNITIES FOR MAINTAINING AND IMPROVING THE ENVIRONMENT

Basic Behavioral Objective: The student will evaluate data against criteria and identify and define existing and potential environmental issues and problems in increasing number and complexity.

Example: Related Learning Activity Behavioral Objective

The student will evaluate collected data against criteria and identify and define opportunities to help prevent environmental abuses, correct existing detrimental conditions and alter the environment to enhance its function and quality.

Example: Related Formal Evaluation Behavioral
Objective

The student will, while observing a series of slides showing selected natural and man-made environmental features, indicate for each feature shown the most important need it doesn't meet by writing its number opposite the appropriate response.

Sample Test Item:

For each of the next five slides, answer the following questions.

To the right is a list of needs which the environment should meet. As you view each environmental feature or condition shown by a slide, select from the list at the right the most important need not being met. Place the number of the need in the blank space after the letter of the slide.

Need Which is NOT
Being Met

SLIDE A _____

SLIDE B _____

SLIDE C _____

SLIDE D _____

SLIDE E _____

Needs Which the Environment
Should Meet

1. A variety of healthy trees and plants
2. Matter (soil nutrients) available and not being lost
3. Man-made things are convenient and efficient to use
4. Man-made things are safe and healthy
5. Parts of the environment are pleasing - enjoyable to look at

PROBLEM - SOLVING SKILLS

(Written to be developed through problem-solving learning experiences)

6. SKILL IN PROBLEM-SOLVING

Basic Behavioral Objective: The student will increase in his ability to select and define issues and problems and efficiently, completely and successfully think through and help carry out the environmental problem-solving processes with selected issues and problems:

- a. Investigate the issue or problem to become informed.
- b. Determine alternative solutions and their consequences.
- c. Evaluate the consequences of solutions and choose appropriate ones.
- d. Develop a plan of action.
- e. Implement the plan of action.
- f. Evaluate the process and results.

(Included in the above are skills related to critical thinking, change strategy and political efficacy.)

Example: Related Learning Activity Behavioral Objective

The student will successfully participate in the process of selecting, planning, and carrying out an environmental problem-solving activity.

Example: Related Formal Evaluation Behavioral

Objective

The student will, given a series of slides and descriptive information related to environmental problems:

- a. define central issues,
- b. correct, complete, and logically arrange a list of problem-solving steps,
- c. identify most likely sources of information,
- d. select the best alternative solutions from several possibilities described,
- e. select the most logical rationale for the alternative solution chosen,
- f. choose a logical plan of action from several described, and
- g. choose the best evaluation procedure from several described.

Sample Test Items:

1. This is a marker along a nature trail which was built near a school to give both students and visitors an opportunity to walk around the site and enjoy it as well as to learn about it. The marker locates and describes for the visitor a special area where certain kinds of wildlife may live.

Imagine you are going to help a class build a nature trail on the school site as these students are doing. Below is a listing of some of the important things to be done.

Number these in the order which you think they should be carried out numbering your first step as one (1).

- _____ Make a map of the locations of different things found on the site.
- _____ Study how the trail is being used and what people think about it so that if changes are needed they can be made.
- _____ Investigate the area which will be used for a nature trail. Find out, study, and describe what is there.
- _____ Choose the one best route to take after considering the problems which might occur with each one planned.
- _____ Make a plan of how the trail will be built; who will do what, when to do it, what is needed for equipment, etc.
- _____ Draw several different routes the trail might take so the visitor will have an enjoyable and educational experience.

2. Here is a stunted and diseased tree on the parking area and playground of a school. The tree is the only one near the school, it provides shade, attracts wildlife, and the students have a great deal of fun playing on it. Some say the tree should be removed because it is obviously sick and dying, falling dead limbs could be a hazard - "a sick tree is a dangerous tree," it takes time to plow around it in winter, and it is in the way for needed parking during most of the year. Others say it is not dying and it's health can be restored by breaking away the tar from around its base so it can get more air and water, its dead limbs can be cut off, a new parking area should be found, and the tree should be left on the site.

Check the statement below which you believe to be correct.

- _____ The main issue here is finding a parking area.
- _____ The main issue here is whether the tree is going to die or not.
- _____ The main issue here is whether or not there should be a tree in the school yard.

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CONCEPTS

(COGNITIVE DOMAIN)

NATURAL ENVIRONMENT CONCEPTS (Natural Ecosystem)

1. NATURAL ECOSYSTEM - STRUCTURE AND FUNCTION CONCEPT

(This example is written to be developed through
Discovery-Inquiry Learning Experiences)

Basic Behavioral Objective: The student will describe and explain with increasing completeness and accuracy the components and ecological characteristics of his total natural environment giving evidence of an understanding of the following basic ecological concept:

a. Natural Ecosystem - Structure and Function

The natural environment of the Earth is essentially a closed and finite system composed of natural ecosystems having:

1) Structure and Components

Structure is related to the diversity of plants and animals, including producers, consumers, decomposers, and transformers which utilize matter-land, water, air and energy.

2) Function

Energy flows and matter cycles through plants and animals at varying rates.

Example: Related Learning Activity Behavioral
Objective

The student will gather and compile information in both written and graphic form which gives evidence

of an understanding of natural ecosystem structure and function.

Example: Related Formal Evaluation Behavioral

Objective

The student will, while observing a series of slides of environmental components, correctly designate descriptive statements as true or false giving evidence of an understanding of natural ecosystem structure and function.

Sample Test Items:

- | | | |
|---|---|--|
| T | F | Soil is limited in amount on Earth and this is different from water which is unlimited in amount. |
| T | F | In nature the minerals in soil are picked up and used by plants. If nature is working properly they will be re-used. |
| T | F | Without green plants like those on this school site, matter from land and the energy from the sun cannot be used by animals. |

2. NATURAL ECOSYSTEM - CHARACTERISTICS, INTERRELATIONSHIPS AND CHANGES CONCEPT

(This example is written to be developed through Discovery-Inquiry Learning Experiences)

Basic Behavioral Objective: The student will describe and explain with increasing completeness and accuracy the components and ecological characteristics of his total natural environment giving evidence of an understanding of the following basic ecological concept:

Natural Ecosystem - Characteristics, Interrelationships, Changes

The characteristics, interrelationships, and changes of components relate to the functioning of natural ecosystems in a process tending ideally toward stability:

- 1) Characteristics of location, diversity, quantity and quality of components are involved in the functioning of the natural environment.
- 2) Interrelationships between components provide for use and cycling of matter and the use and flow of the sun's energy.
- 3) Changes occur continually in both the structure and function of natural ecosystems.

Example: Related Learning Activity Behavioral Objective

The student will gather and compile information in both written and graphic form which gives evidence of an understanding of natural ecosystem characteristics, interrelationships, and changes.

Example: Related Formal Evaluation Objective

The student will, while observing a series of slides of environmental components, correctly designate descriptive statements as true or false giving evidence of an understanding of natural ecosystem characteristics, interrelationships, and changes.

Sample Test Items:

- T F Keeping track of the kinds and members of animals on the site will not help us find out about natural changes that may be occurring on the site.
- T F All animals, including this frog, depend upon plants for food and energy.
- T F The amount of soil is likely to change more quickly here because of water rather than because of air, plants, or animals.

3. NATURAL ECOSYSTEM - STABILITY CONCEPT

(This Example is Written to be Developed Through Evaluation-Problem Identification Learning Experiences)

Basic Behavioral Objective: The student will develop evaluative criteria and identify and define an increasing number of existing and potential issues and problems of increasing complexity giving evidence of an increasing understanding of the following natural ecosystem concept:

Natural Ecosystem Stability

Stability is a measure of a healthy and lasting environment and results from natural ecosystems possessing characteristics, interrelationships, and changes which reflect:

a. Structure

- 1) a complex network of diverse species with balanced populations.
- 2) availability of matter.

b. Function

- 1) efficient utilization of energy
- 2) efficient cycling of matter

Example: Related Learning Activity Behavioral
Objective

The student will develop evaluative criteria and identify and define existing and potential issues and problems which are based upon and give evidence of an understanding of the concept of natural ecosystem stability.

Example: Related Formal Evaluation Behavioral
Objective

The student will, while observing a series of slides showing a variety of natural ecosystem environmental conditions, give evidence of an understanding of natural ecosystem stability by identifying features or conditions which meet or do not meet this need.

Sample Test Item:

A stable natural environment is one which is healthy and lasting - that is, it tends to resist changes which might be harmful to it.

- a. In the slide, which of the areas is most stable?
(Circle the number of your choice.)

- 1) the area with trees
- 2) the grassy lawn area
- 3) the bare ground

b. Which is least stable? (Circle the number of your choice.)

- 1) the area with trees
- 2) the grassy lawn area
- 3) the bare ground area

MAN AND ENVIRONMENT CONCEPTS (Human Ecosystem)

1. HUMAN ECOSYSTEM - STRUCTURE AND FUNCTION CONCEPT

(This Example is Written to be Developed Through
Discovery-Inquiry Learning Experiences)

Basic Behavioral Objective: The student will describe and explain with increasing completeness and accuracy the past, present, and future role of man as a steward and creator of his environment giving evidence of an understanding of the following basic human ecosystem concept:

Human Ecosystem - Structure and Function

Man experiences stewardship and provides for his needs by working on the natural environment through an institutional system of man-to-man relationships and a technological system of man-to-environment relationships to produce and manage the following components of the man-made environment:

- 1) Production areas
- 2) Human settlement areas
- 3) Open space areas
- 4) Transportation and circulation areas

- 5) Recreational areas
- 6) Community service and utility areas

Example: Related Learning Activity Behavioral
Objective

The student will gather and compile information in both written and graphic form which gives evidence of an understanding of the structure and function of the human ecosystem.

Example: Related Formal Evaluation Behavioral
Objective

The student will, while observing a series of slides of environmental components, correctly designate descriptive statements as true or false giving evidence of an understanding of human ecosystem concepts.

Sample Test Item:

- T F The safe operation of a circulation area, such as the one shown here, requires only a good design using lasting materials.

2. HUMAN ENVIRONMENTAL DEPENDENCY AND NEEDS CONCEPT

(This Example is Written to be Developed Through
Evaluation-Problem Identification Learning
Experiences)

Basic Behavioral Objective: The student will develop evaluative criteria and identify and define an increasing number of existing and potential environmental issues and problems of increasing complexity giving evidence of an increasing understanding of the following concept:

Man is the linking component between the natural environment upon which he is dependent and of which he must be a steward and the man-made environment which he creates to help provide for physical, psychological and social needs:

- a. Human physical needs are provided for by environmental components which function and possess characteristics related to:
 - 1) convenience and efficiency
 - 2) safety and health
 - 3) durability or lastingness
- b. Human psychological needs are met by components which are pleasurable to the senses.
- c. Human social needs are met by components which assist people to live in harmony together, to interact and to gain a measure of individual and group recognition.

Example: Related Learning Activity Behavioral

Objective

The student will develop evaluative criteria and identify and define existing and potential issues and problems which are based upon and give evidence of an understanding of the concept of human environmental dependency and needs.

Example: Related Formal Evaluation Behavioral

Objective

The student will, while observing a series of slides of man-made environmental conditions, give evidence of an understanding of the concept of human environmental dependency and needs by correctly designating descriptive statements as true or false.

Sample Test Item:

T F The major human needs which areas such as the one pictured here must meet are:

- 1) our mental needs for a pleasing environment, and
- 2) our social needs to get along well with people

3. ASSOCIATED ENVIRONMENTAL PROBLEMS CONCEPT

(This Example is Written to be Developed Through Problem-Solving Learning Experiences)

Basic Behavioral Objective: The student will increasingly select existing and potential issues and problems and choose, plan and help carry out solutions to problems which reflect an understanding of the following concept:

Environmental issues and problems are often associated with the sizes, concentration, physical characteristics and mental characteristics of the human population and result from the lack of effective individual citizen, institutional and technological response to existing and future effects of ecological and human demands upon the environment.

Example: Related Learning Activity Behavioral

Objective

The student will select a problem and help investigate and report on the causes and effects of the problem, determine alternative solutions, choose a solution, develop and carry out a plan of action and plan and implement an evaluation procedure which give evidence of an understanding of concepts related to the role of man and the total environment.

Example: Related Formal Evaluation Behavioral

Objective

The student will, given a series of slides, select environmental problems and choose alternative solutions with appropriate rationales which demonstrate a knowledge of basic concepts related to the role of man and the total environment.

Sample Test Item:

Here is an example of litter on the school site. Which of the steps below do you think best to use to help solve the problem? (Circle the number of your choice.)

- 1) Tell those responsible that the problem exists on the school site.
- 2) Hold a school assembly and give a slide presentation showing the causes, effects, and solution to the problem followed by a discussion of what each individual can do.
- 3) Gather a list of signatures on a petition to have the school adopt a law which will require each person responsible for the problem caught to be fined or to clean up the area.

SELF - CONCEPT

(This Example is Written to be Developed Through
Discovery-Inquiry Learning Experiences)

Basic Behavioral Objective: The student will demonstrate an increasing knowledge of his needs, abilities, limitations, and potential by independently selecting, efficiently and skillfully carrying out, and successfully completing appropriate environmental investigations of an increasing complexity and challenge.

Example: Related Learning Activity Behavioral
Objective

The student will work independently in selecting, efficiently and skillfully carrying out and successfully completing investigations and will select and successfully complete challenging optional assignments related to his selected topic for study.

Example: Related Formal Evaluation Behavioral
Objective

The student will accurately indicate whether or not he has correctly answered selected test questions.

Sample Test Item:

Of the five true and false questions you answered, how many do you think you answered correctly? _____

SOCIAL CONCEPT

(This Example is Written to be Developed Through
Evaluation - Problem Identification Learning
Activities)

Basic Behavioral Objective: The student will demonstrate an increasing knowledge of the needs of others including future generations by the way he works with others, by developing and applying evaluative criteria which accurately reflect their needs and by identifying important issues and problems.

Example: Related Learning Activity Behavioral
Objective

The student will work harmoniously and successfully with others and will develop criteria which accurately and completely reflect a knowledge of the needs of others including future generations and will identify issues and problems which reflect a knowledge of the needs of others.

Example: Related Formal Evaluation Behavioral
Objective

The student will indicate a concern for environmental issues and problems which demonstrates a knowledge of the environmental needs of others including future generations.

Sample Test Item:

For each problem which you have identified indicate how much you care or are concerned that the problem be solved by circling a number. Use the key below:

I am:

strongly unconcerned	= 1
unconcerned	= 2
undecided	= 3
sure	= 4
strongly concerned	= 5

FEELINGS

(AFFECTIVE DOMAIN)

1. FEELINGS TOWARD NATURE

(This Example is Written to be Developed Through
Discovery-Inquiry Learning Activities)

Basic Behavioral Objective: The student will, through discussion, writing, reading, audio-visual media, and firsthand experiences create and utilize an increasing number of opportunities to explore past, present, and future aspects of his natural environment.

Example: Related Learning Activity Behavioral Objective

The student will select and complete optional assignments related to his selected topic for study.

Example: Related Formal Evaluation Behavioral Objective

The student will indicate a high degree of interest on a Likert scale in learning about environmental components.

Sample Test Item:

Circle the number of your choice to make the sentence complete.

I am:

<u>strongly not</u>	<u>not</u>	<u>undecided</u>	<u>strongly</u>
<u>interested</u>	<u>interested</u>	<u>neutral</u>	<u>interested</u>
1	2	3	4
			5

in learning about the natural environment including land, water, air, plants, animals and energy.

Example: Related Unobtrusive Evaluation Behavioral
Objective

(The student is unaware that he is
being evaluated)

The student will indicate on an optional take-home
questionnaire for a community organization an
interest in investigating natural environmental
components.

Sample Test Item:

Below are listed a variety of topics related to the
environment about which information is needed. Indicate
the extent of your interest in the topics by circling
one of the numbers according to the key below.

strongly not interested	= 1
not interested	= 2
undecided/neutral	= 3
interested	= 4
strongly interested	= 5

- | | | | | | |
|-------------------------|---|---|---|---|---|
| a. Land - soils, rocks, | 1 | 2 | 3 | 4 | 5 |
| minerals, surface | | | | | |
| features | | | | | |
| b. Etc. | | | | | |

2. FEELINGS TOWARD THE ROLE OF MAN

(This Example is Written to be Developed Through
Problem-Solving Learning Activities)

Basic Behavioral Objective: The student will increasingly select existing and potential issues and problems and choose, plan, and help carry out solutions which place man in the role of steward and creator of a quality environment.

Example: Related Learning Activity Behavioral
Objective

The student will select an issue or problem and help choose and carry out solutions which relate to man's role as a steward and creator of a quality environment and will select and complete optional assignments which reflect a positive feeling towards the role of man as a steward and creator of a quality environment.

Example: Related Formal Evaluation Behavioral
Objective

The student will, given a series of slides, select environmental problems and choose alternative solutions with appropriate rationales which demonstrate a high value towards the role of man as a steward and creator of a quality environment.

Sample Test Item:

Following are six slides of six environmental problems. After viewing the problems and reading the brief description and the possible solutions to each one, select the solution you best agree with by circling the number of your choice.

Problem Five: Broken outfield fence on the school baseball field. The school only has enough money to repair the fence, not to replace it which will need to be done eventually.

Solutions:

1. Students should repair the fence replacing broken boards with the money. This would require some of your time.
2. Save the money until more is raised by the town to remove the fence and build a better one. This wouldn't require any of your time. It would mean, however, that it would be some time before the fence is repaired.
3. Students should conduct a campaign to raise money to have a new fence placed on the site. This would require more of your time.
4. Do nothing with the fence - it isn't necessary for the game.

Example: Related Unobtrusive Evaluation Behavioral

Objective

The student will, on a field trip introduced to him as a survey of the school site in preparation for a course, refrain from littering when given the opportunity and will pick up litter planted along the field trip route.

3. FEELINGS TOWARD ONESELF

(This Example is written to be Developed Through
Problem-Solving Learning Activities)

Basic Behavioral Objective: The student will demonstrate an increasing belief in his own abilities by attempting to participate in an increasing number of environmental problem-solving activities, by working independently where assistance from others is unnecessary and by continuing in cases where his self-image may be threatened.

Example: Related Learning Activity Behavioral
Objective

The student will participate in problem-solving activities electing to work independently where assistance from others is unnecessary and attempting to continue in challenging situations selecting challenging optional assignments.

Example: Related Formal Evaluation Behavioral
Objective

The student will indicate on a Likert scale a high confidence in his ability to successfully participate in environmental problem-solving activities.

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Sample Test Item:

Following are four slides of four environmental problems. First, after viewing the problems and reading the brief description, answer the questions.

Secondly, indicate by circling a number from one to five how much you feel you can help solve each problem. Use the following key:

I am:

strongly not confident	= 1
<u>not</u> confident	= 2
undecided	= 3
confident	= 4
strongly confident	= 5

that I can help and contribute to solving the problem.

Example: Related Unobtrusive Evaluation Behavioral
Objective

The student will indicate on an optional take-home questionnaire for a community organization a strong belief in his ability to successfully participate in environmental problem-solving activities.

Sample Test Item:

Indicate by circling a number on the scale below the extent to which you feel you could actually help contribute to the solution of those problems you are concerned about.

I am:

strongly not confident	not confident	undecided	confident	strongly confident
1	2	3	4	5

that I could actually help contribute to the solution of environmental problems I am concerned about.

4. FEELINGS TOWARD OTHERS

(This Example is Written to be Developed Through Evaluation - Problem Identification Learning Activities)

Basic Behavioral Objective: The student will demonstrate an increasing sensitivity and concern for the needs of others including future generations by the way he works with others and by reflecting their needs in the criteria and values he attaches to the issues and problems he identifies and defines.

Example: Related Learning Activity Behavioral Objective

The student will attempt to work harmoniously with others and develop criteria which relate to the needs of others including future generations.

Example: Related Formal Evaluation Behavioral Objective

The student will arrange a series of problems in an order of concern which places a high priority on maintenance and improvement of the environment for the benefit of all people including future generations.

Sample Test Item:

Number the following problems in the order of your concern with the highest number (5) representing your strongest concern (how much you care) that the problem should be corrected and the lowest number (1) your weakest concern.

- _____ The open burning community dump with its problems of air pollution, pests, and unsightliness.
- _____ The planting of flowers and shrubs to beautify your home today.
- _____ The building of a pond to provide water for recreation within a short time.
- _____ The planting of trees as a screen and windbreak 30 years into the future.
- _____ The picking up of litter around your home to beautify it.
- _____ The removal of sources of river pollution which will still take 10 years for the river to clean itself.

Example: Related Unobtrusive Evaluation Behavioral
Objective

The student will indicate on an optional take-home questionnaire for a community organization a high concern for evaluating problems affecting the welfare of others including future generations.

Sample Test Item:

Indicate the extent of your interest in the evaluation tasks listed below by circling one of the numbers (using the key as given in Question 1).

- | | | | | | |
|--|---|---|---|---|---|
| a. Carrying out studies near your own home for projects of immediate benefit to your neighborhood | 1 | 2 | 3 | 4 | 5 |
| b. Carrying out studies which will benefit the whole community | 1 | 2 | 3 | 4 | 5 |
| c. Carrying out investigations to find areas which can be set aside and developed to benefit people in the future. | 1 | 2 | 3 | 4 | 5 |

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APPENDIX A
EVALUATION CONSIDERATIONS

EVALUATION CONSIDERATIONS

The following are major considerations guiding the design of evaluation techniques.

1. Applicability and Reproducibility

The ultimate contribution of evaluation techniques is, in a large measure, dependent upon applicability and reproducibility. Applicability refers to the usefulness of the evaluation techniques in measuring selected variables, i.e., skills, concepts and feelings. By reproducibility is meant the ease with which teachers can repeat the evaluation procedures in their own teaching situations. Researchers have long encouraged others to repeat their experiments and tests. In education this is essential if widespread use of procedures is to occur. To meet this criterion evaluation instruments and techniques must be logical in development, easy to administer directly and subject to straight-forward analyses.

2. Types of Evaluation Techniques

Three types of evaluation techniques are considered in this booklet: the formal pencil-and-paper instrument; unobtrusive measures; direct observation of the student participating in the learning process.

Formal Pencil-and-Paper Evaluation

First to be considered are the pencil-and-paper tests which are popular among researchers. These are predominantly of the questionnaire design.

Among major considerations of traditional pencil-and-paper tests are the following:

- a. Probably a primary shortcoming is one which has been aptly called the "guinea pig effect" which is the awareness of being tested. This may cause the respondent to try to guess what the researcher is looking for and answer accordingly, or he may choose to answer in ways deliberately invalidating the test. However, according to Webb, et al., "The threat of subjects' awareness of being tested is less an issue in educational research..."⁶
- b. Lack of motivation may also occur with these kinds of tests. In this case the test might be viewed by the respondents as having little relevance. The difference between conditions surrounding the testing situation and the "real world" could contribute to this feeling.
- c. A pencil-and-paper test may weigh the instrument in favor of those with verbal, reading, and writing skills. Thus, it may differentiate according to capacity to use language and ability to communicate. For some tests these may be variables to measure, however.
- d. These kinds of tests may not be an appropriate version of the phenomenon under consideration and, thus, contribute to respondent uncertainty and lack of familiarity with the problem.
- e. Concerning the area of attitudes and values, there are several considerations. For example, questionnaires intrude into the social setting and can create as well as measure attitudes. Still, according to Raths, Harmin, and Simon, pencil-and-paper tests which obtain what respondents say they value have been most used to measure values. Action based on choices, according to them, should be a major criterion for a value. But, they concluded, "A pencil-and-paper instrument validated on behavior would, of course, be as useful as it would be difficult to perfect....." And so, perhaps, this explains the continued use of written attitude tests such as Thurstone's, Likert's, Guttman's and Osgood's. These are built upon two assumptions: (1) subjective attitudes can be measured quantitatively and (2) each test item has the same meaning for everyone.

Concerning the Likert scale, Sellitz, et al., referred to the relative ease in constructing it and wrote that "...pragmatically the scores ... often provide the basis for a rough ordering of people on the characteristic being measured." They also believe that "The fact that different patterns of response may lead to identical scores...is not necessarily as serious a drawback as it may at first appear." With this scale technique it is common to total the individual ratings of related objects or items to find a person's attitude score.⁷ Such scale techniques have also been reported by Robinson and Shaver to measure values.⁴ Finally, traditional attitude tests should be supported and augmented wherever possible with other methods for no method is without bias. Again according to Webb, et al., "If a proposition can survive the onslaught of a series of imperfect measures, with all their irrelevant errors, confidence should be placed in it."⁶ In the area of attitude and value measurement, therefore, it is urged that consideration be given to using unobtrusive measures for data collection in particular.

Unobtrusive Evaluation Techniques

Unobtrusive measures are techniques which aim to avoid intrusion into the social setting and the chance that subject reactions will invalidate a test. These measures consist of contrived and simple observation of behavior during which the subject is unaware that he is being evaluated. As pointed out above, techniques of this kind are particularly useful when measuring in the affective domain. If a subject is aware of being tested, his feelings are likely to be affected, thereby short-circuiting the chance of getting a true measure of feeling, e.g., interest or concern. For this reason unobtrusive measures should be included in the evaluation design if possible.

Process Evaluation

A third technique to be included here is the direct observation of students involved in the learning processes. The important considerations here are to specify the kinds of behavior which will give

evidence that the learner is likely to have acquired desired feelings, concepts, and skills and to consciously look for their occurrence during the learning process. Such a technique is consistent with the generally accepted idea that evaluation should be an on-going process.

3. Effects of Extraneous Learning Experiences

If environmental education is but an emphasis in the curriculum and is concerned with the total human ecosystem, it follows that it must be interdisciplinary. Like the ecologist who is needed because he brings a knowledge and perspective to the relationships between many specialized sciences and contributes to an understanding of the whole, so does the strength of environmental education lie in its linking of all parts of the curriculum. It brings the knowledge and skills associated with many disciplines to bear on the task of helping individuals investigate the environment and recognize and help resolve environmental problems. Both the rapid increase in specialized knowledge and the increase in social and environmental problems call for an approach specializing in breadth of understanding which environmental education brings to the curriculum. In view of the foregoing, then, all learning experiences in the curriculum are justifiably within the scope of environmental education. However, since environmental education has adopted the specific goal of clarifying man's environmental relationships and helping him to achieve a quality environment - an ethical aim which has been repeatedly validated by widespread expressions of concern throughout the Country - specific learning experiences associated with this aim may be identified and judgements made concerning degree of relatedness. The point to be made is that one cannot expect clear-cut, sharply differentiated learning effects attributable only to environmental education learning experiences. The boundaries between environmental education and the disciplines is fuzzy at best. In evaluating these effects probably the best that can be done is to emphasize the degree and probability of their relationships to the learning experiences.

The problem this booklet deals with is to develop methods which will show that environmental education learning experiences can contribute to the education of youth. With a scope of effort as broad as

environmental education's, this is admittedly difficult to accomplish. However, to overcome this problem, a clear identification of two broad outcomes has been suggested: (1) value areas related to the ecological view or value realm and (2) thinking and behavioral skills necessary for not only value development (valuing) but for bringing values to bear on problem resolution. In developing and validating an instrument, it is suggested that timing be a major way of factoring out extraneous learning experiences. A pretest is suggested given immediately before working with a class involved in the process phases of environmental education to gather base-line data and a post-test given immediately following to provide assessment of learning experiences.

4. Pretest - Post-test Contamination

Pretest - post-test designs are useful for evaluating the effects attributable to exposing subjects to experimental variables. In education they provide an opportunity to assess the worth of teaching methods and learning experiences. However, the problem with such designs is one of contamination, often called testing sensitization. Briefly, this refers to the danger that the pretest may become in itself a change agent by influencing the subject's attitudes and affecting the measurement results of the post-test. The shift in measurement or artifact produced by the pretest may cloud the amount of change that might be attributed to the learning experiences prior to the post-test. This particularly affects the internal validity of the test or how well it measures what it purports to measure as well as the external validity - how generalizable the results are. In view of the foregoing the following design considerations have been identified:

- a. A pencil-and-paper instrument should present a variety of problems and call for choices reflecting value judgements and critical thinking skills. The value oriented nature of such a test may then contribute to the difficulty of the respondent to perceive correct answers and anticipate the intent of questions. Thus the problem of contamination may be somewhat diminished.

- b. A study may utilize a research design where a portion of a participating class receives the pretest, learning experiences, and all receive the post-test. Such a design is diagrammed below:

S = subjects

P = pretest and post-test

L = learning experience

Experimental	S	P	L	P
Group	S		L	P
Control Group	S	P		P
	S			P

Of this design Kerlinger wrote that for the following reasons it is "...a design with potent controls.": (1) comparisons can be effectively carried out, (2) randomization assures statistical equivalence, (3) history and maturation are controlled, (4) possible interaction effect due to possible pretest subject sensitization can be controlled, and (5) possible temporary contemporaneous effects can be controlled.² Campbell has also written that this design has become the new ideal for social scientists.¹

- c. Care should be taken to avoid administration inconsistencies between the pretest and post-test. This refers to differences in instructions, time length, distractions, time of day, etc.
- d. In addition, consideration should be given to utilizing one or more unobtrusive measures designed to be used for pre-test and post-test evaluations. A variety of unobtrusive information sources may be explored, including public address announcements over the school intercom system, classroom bulletin board bulletins, handouts from community organizations, and the introduction of visible problems on the school grounds or in the community. The number

of students responding and nature of their responses may be correlated with the timing of environmental education learning experiences and other measuring techniques.

5. Reliability and Validity

Perhaps the above considerations may be best summed up in a brief discussion of reliability and validity including related design techniques. Reliability refers to the extent to which variations in evaluation scores is due to inconsistencies in measurement. It may be checked by comparing test scores with scores from other tests for consistency.

Validity refers to the extent to which the techniques and instruments actually measure the variables being examined. Some considerations are:

- a. The research experimental-control design suggested earlier is such that significant effects of extraneous variables may be detected using statistical analysis. This involves: (1) comparing the pretests of the experimental pre-post-test group with the pretests of the control pre-post-test group to detect differences at the beginning of the experiment and (2) comparing the post-test scores of the combined experimental and control pre-post-test groups with the combined experimental and control post-test groups to detect differences attributable to the effects of the pre-test on the post-test or other intervening extraneous variables.

Zimbaro and Ebbesen reported that this design, which they identified as the Solomon four-group design, is one of several highly sophisticated experimental designs which minimize sources of invalidity. They indicated that the design removes all the following sources of internal invalidity: (1) external artifacts, (2) subject changes, (3) testing sensitization, (4) problems with equipment, (5) subject selection biases, and (6) attrition. Concerning external sources of invalidity, they indicated removal of: (1) reactive measurements and (2) multiple treatment effects. Only a maybe was given for interaction of selection biases and

experimental variable and for reactive effects of experiment.

- b. Content validity may be assessed by having a panel independently rate each question in an instrument according to whether it is likely or unlikely to test the variable towards which it is directed or whether it should receive an undecided vote.
- c. Predictive validity or pragmatic validity refers to the usefulness of the instrument as an indicator or predictor of some other behavior or characteristic. It may be predicted that those who score high in possessing an ecological value system would be more apt to engage in activities involving acting on such a value system. As a check on predictive validity, unobtrusive test measures may be designed.
- d. Construct validity refers to the degree the instrument reflects constructs or abstract characteristics which cannot be identified with some specific kind of behavior. This may be assessed to an extent by having a panel independently place each of the questions or test items in categories according to test variables with one undecided category.

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APPENDIX B

Example
of a
UNIT OUTLINE

THE SCHOOL SITE ENVIRONMENT

One 80 Minute Period Per Day

WEEK 1

UNOBTRUSIVE - Citizen Questionnaire and School Site Survey

1. The need for environmental quality
2. The roles of citizens

1. Natural & man-made components of the environment
2. Natural and human ecosystem concepts

1. Map of shape and size of site
2. Identification of natural and man-made features - location, shape, size, amount, characteristics.

1. Kind
2. Location
3. Size - Shape
4. Amount
5. Characteristics

- B. Demonstration of equipment and techniques for environmental investigation
- C. Student selection of topics to investigate
- D. Guidelines for compiling and mapping information

THURSDAY: Student field investigation of natural and man-made environmental components

FRIDAY: A. Student compilation of information, writing of reports, development of maps

PHASE II: Evaluation - Problem Identification

- B. Presentation with slides
 - 1. Criteria for evaluating the natural environment
 - 2. Criteria for evaluating the man-made environment

WEEK 2

- MONDAY:
- A. Review of environmental evaluation concepts
 - B. Introduction to environmental evaluation assignment sheets
 - C. Student field environmental evaluation of the school site
 - D. Class discussion - identification of opportunities for environmental improvement

-
- TUESDAY:
- A. Introduction to kinds of environmental problems
 - B. Student field identification and listing of problems for student involvement

PHASE III: Problem Solving

- C. Introduction to the problem-solving process

-
- WEDNESDAY: A. Student selection of problems to help resolve
- B. Student preparations for problem-solving
1. Description of the problem (why a problem, etc.)
 2. Listing of alternative solutions
 3. Selection of best solution - reasons, etc.
 4. Planning for action
 5. Listing of tools, equipment and supplies needed
-

- THURSDAY: A. Student field problem-solving activities
- B. Review of projects
- C. Review of unit phases
-

FRIDAY: UNIT POST-TEST (same as pretest)

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APPENDIX C
RESULTS of an EVALUATION

RESULTS OF AN EVALUATION

During April and May of 1972, a study was conducted utilizing the methods and techniques outlined in this handbook. Approximately seventy-five (75) students were involved representing grades six through eight in the Freeport, Maine, Junior High School. The students had elected to take a two-week course in environmental education meeting eighty minutes per day, five days per week. The students were divided into three classes of approximately twenty-five each and scheduled according to school group divisions for three two-week classes covering a time span of six weeks.

Using the basic behavioral objectives presented in this booklet as a guide, a two-week unit was developed focusing on the environment of the school site. Unit behavioral objectives and learning activities were planned which would involve the students in classroom and firsthand investigations, evaluation-problem identification and problem solving. These three kinds of learning experiences represented the process of environmental education or independent variable. The unit behavioral objectives in addition provided guidelines for observations of the students while engaged in the process.

Following the development of the teaching unit, behavioral objectives were written for the formal pencil-and-paper test. These were also drawn from the basic behavioral objectives. Using the formal evaluation behavioral objectives as a guide, test items were then devised for the pencil-and-paper instrument. Since all behavioral objectives followed Mager's suggestions that they state what the students would be expected to do as well as the extent and under what conditions, the development of test items from the objectives was facilitated. During this part of the design process, slides were selected to accompany the questions. Several hundred were reviewed. The slides served two purposes: (1) for some questions the slides provided a visual image about which students were asked to react and (2) for other questions the slides served merely as stimuli for the students concerning the topic of the question.

Following the development of the first draft of the instrument it was pretested with twenty-five students participating in the first two-week unit. Also during the two-week time period the unit was refined.

Upon completion of the pretest of the formal instrument's first draft, the test was evaluated and revised to increase its validity, sensitivity, and time appropriateness.

Prior to the administration of the final version of the instrument, the names of students participating in the experimental group were procured. This group was the second class of twenty-five students receiving the unit during the middle two weeks of the six-week time span. Each student in the experimental group was then assigned a number from one to twenty-five. Using a list of random numbers, thirteen students were randomly selected to receive the formal pretest. All were to receive the formal post-test.

At the same time, the names of students who were to receive the unit during the last two weeks were procured. These students became the control group during the middle two-week period. As with the experimental group, thirteen students were randomly selected to receive the formal pretest. This group was to receive the pretest at the same time as the experimental group. All students of the control group were to receive the formal post-test.

All pretests were administered during the first class session of the unit. The post-tests were administered during the last session with the exception of the control group. For this group the post-test was administered following a weekend three days later during their first class session. This was convenient in that no special scheduling was required.

Following the administration of the formal test instrument, data were tabulated for pre and post-test results.

Both descriptive and inductive statistical analyses were used. The inductive statistical analysis consisted of a series of five t-tests run on the nine sub-tests of the instrument. These tests were two-tailed and run at the .05 ALPHA level. The tests sought to answer the following research questions:

1. Were experimental and control groups equal at the beginning of the two-week experiment on the nine areas of the instrument?
2. After two weeks in the program, did the Experimental Pre-Post-test Group score higher on the post-test than on the pretest in any of the nine areas?

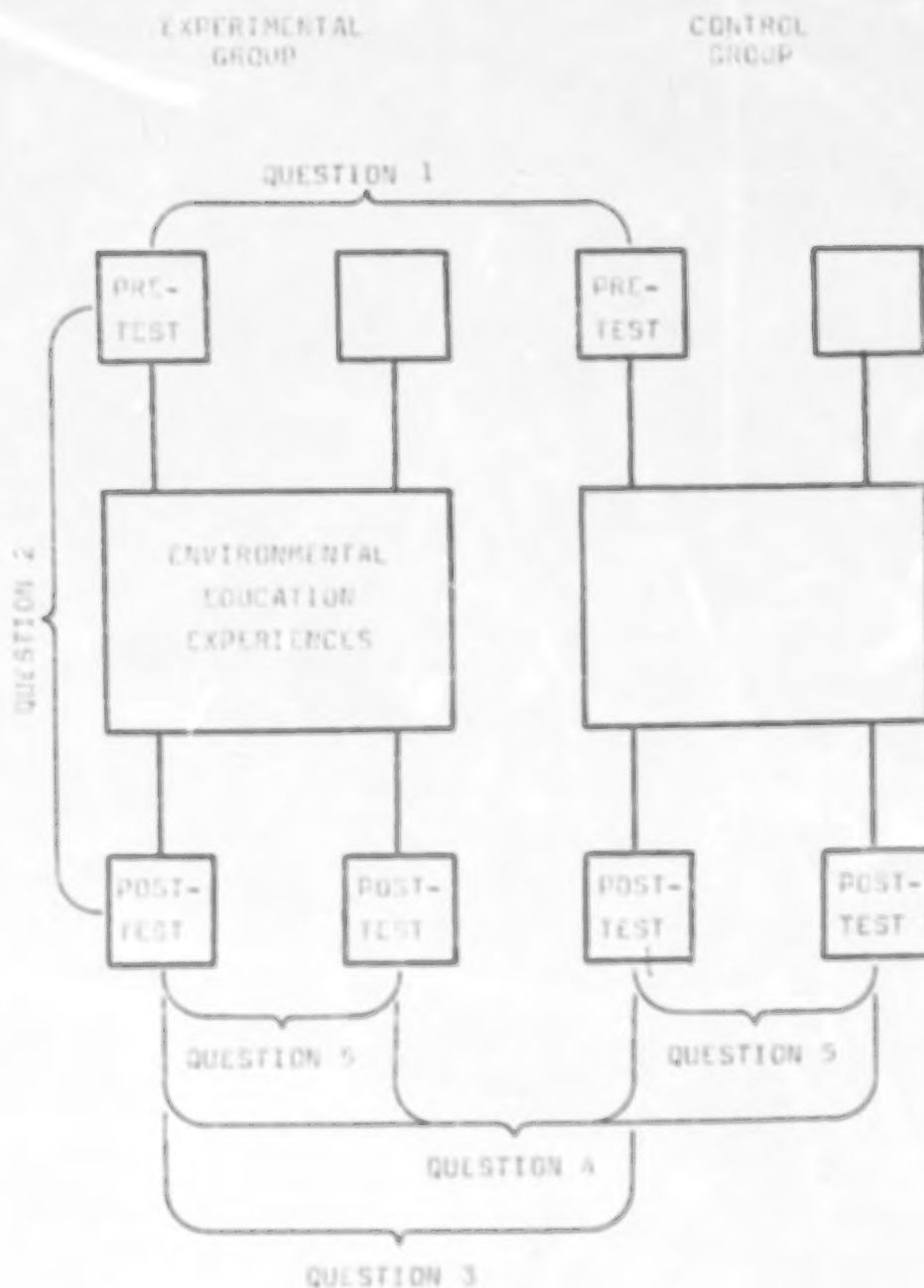
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3. After two weeks in the program, was the gain made by the Experimental Pre-Post-test Group greater than the gain made by the Control Pre-Post-test Group in any of the nine areas?
4. After two weeks in the program, were the post-test results of the combined experimental groups (Pre-Post-test Experimental Group and Post-test Experimental Group) greater than the post-test results of the combined control groups (Pre-Post-test Control Group and Post-test Control Group) in any of the nine areas?
5. Did taking a pretest affect results on a post-test taken two weeks later in any of the nine areas?

Figure 1 is a diagram of the relationship of the questions to the research design.

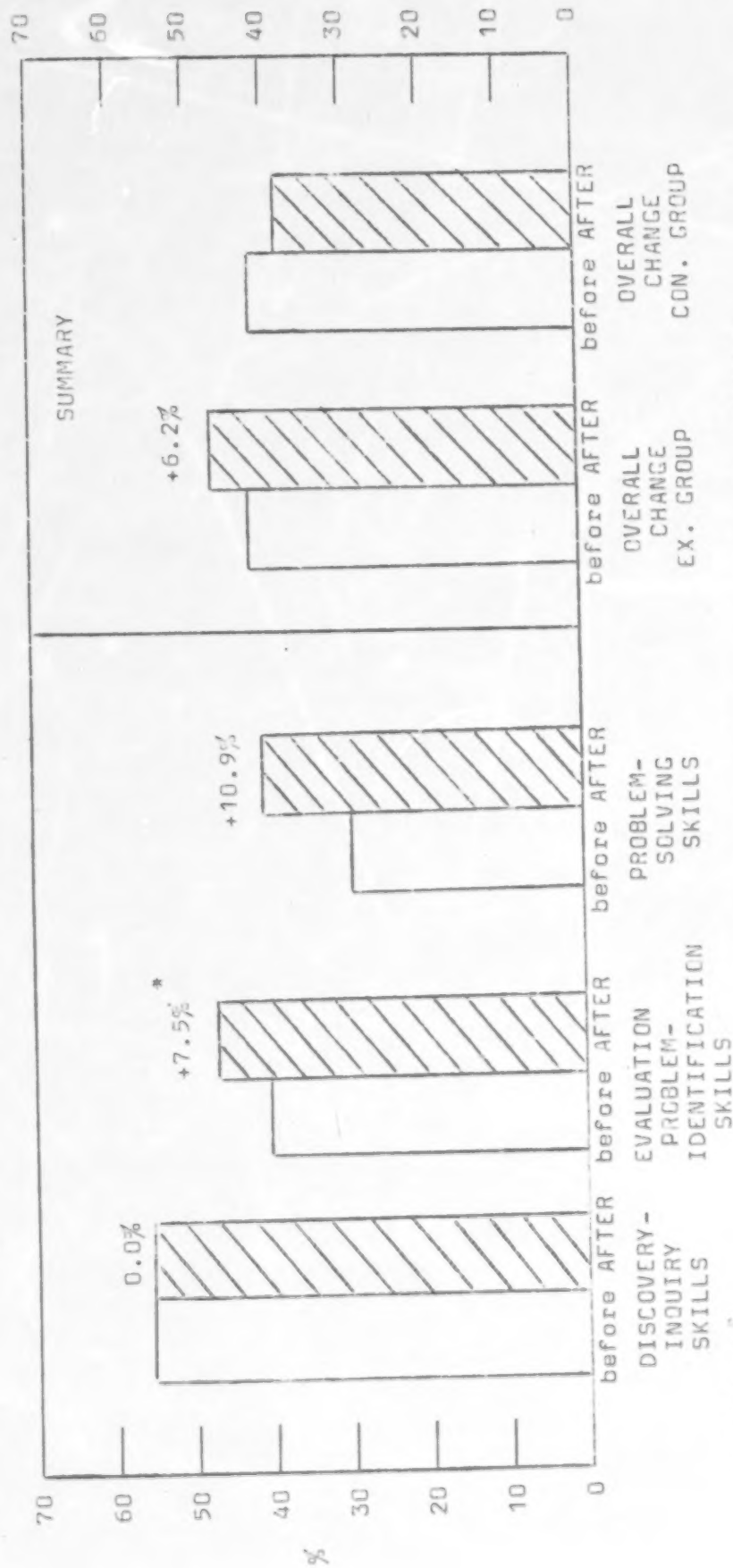
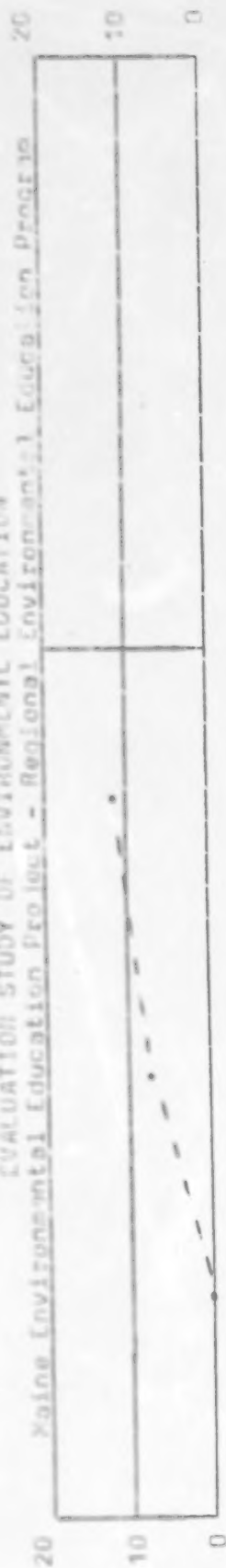
One set of results is of particular interest. Within the variable Ability to Act on an Ecological Value System are three sub-variables. The first of these, Discovery - Inquiry, showed no descriptive change between pre and post-tests of the Experimental Group. The second, Evaluation - Problem Identification, revealed a 7.5 mean percent increase while the third, Problem Solving, showed a 10.9 mean percent increase. An interpretation of this might be based on the fact that the first sub-variable is related strongly to traditional methods of education whereas the latter two represent areas to which students are not normally exposed. Therefore, one might expect greater learning to occur with respect to them. See Figure 2.

Figure 1. Relationships of research questions to research design



EVALUATION STUDY OF ENVIRONMENTAL EDUCATION

Yaine Environmental Education Project - Regional Environmental Education Program



*STATISTICALLY SIGNIFICANT
.05 LEVEL

ABILITY TO HELP MAINTAIN AND IMPROVE A QUALITY ENVIRONMENT
EFFECT OF ENVIRONMENTAL EDUCATION LEARNING EXPERIENCES
Two-Week Unit focused on the School Site Environment - 80 Min. Per Day
Freeport Junior High School

FIGURE 2